

**WE CLAIM:**

1. ~~A method for vending beverages packaged in sealed containers, comprising:~~

- a. storing a plurality of packaged beverages in selectable queues of containers of such beverages within a vending machine;
- b. aligning a robotic assembly in the machine in registration with a customer selected one of said beverage container queues;
- c. transferring one of the beverage containers from the selected container queue to the robotic assembly;
- d. carrying the transferred beverage container to a delivery port of the vending machine; and
- e. presenting the carried beverage container at the delivery port for customer removal from the vending machine; wherein the entire process is performed without dropping or subjecting the container to severe impact forces.

2. The method of Claim 1, including the step of arranging the beverage containers on shelves within the machine in ordered contained rows of said containers, said rows extending generally in a direction from front to back of the machine.

3. The method of Claim 2, wherein the step of arranging said containers includes separating said rows of containers by shelf dividers extending generally in a direction from front to back of the machine.

4. The method of Claim 2, including the step of inclining at least one of said beverage containing shelves at an inclined angle to the horizontal from front to back of the shelf; whereby containers carried by said shelf are urged by gravity toward the front of the shelf.

5. The method of Claim 1, including the step of arranging a plurality of the beverage containers in contained alignment within a plurality of selectable identifiable

6. The method of Claim 5, including the step of configuring said plurality of trays in generally vertical columns as viewed from the front of the machine.

8. The method of Claim 1, wherein the step of carrying includes moving said transferred beverage by said robotic assembly in a generally vertical X-Y plane of travel within said vending machine.

~~10. The method of Claim 9, wherein the step of removing the bottled beverage comprises removing the bottled beverage from said one of the ordered queues by a robotic assembly.~~

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11. The method of Claim 9, wherein the step of moving the bottled beverage comprises smoothly moving the bottled beverage by said robotic assembly in a generally vertical X-Y plane within a vend selection space of the vending machine.

~~12. The method of Claim 9, wherein the step of removing said bottled beverage comprises smoothly sliding said bottled beverage being removed from said one of said ordered queues into a robotic assembly.~~

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13. The method of Claim 12, wherein the step of removing said bottled beverage includes releasing an escapement mechanism associated with said one of said ordered queues for enabling the bottled beverage being removed to slide by gravity into said robotic assembly.

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14. A method of vending discrete products from a vending machine of the type having a transparent viewing panel for customer viewing and selection of the products to be vended, and a support for supportably holding said products for visual presentation to a customer through said viewing panel; comprising the steps of:

- a. ordering said products in a plurality of selectable queues of said products on said support such that a foremost one of said products in each of said queues addresses the viewing panel at a dispensing end of its associated queue;
- b. moving a capture assembly into alignment with the dispensing end of a customer selected one of said queues;
- c. transferring the foremost one of said products from said customer selected one of said queues into retainment by said capture assembly;
- d. moving said capture assembly with its retained product in view of said viewing panel to a delivery port;
- e. enabling customer removal of said retained product from said capture assembly at said delivery port; and

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a. moving said capture assembly to activate an escapement mechanism at the dispensing end of said customer selected one of said queues; and

~~16~~<sup>12</sup>. The method of Claim ~~14~~<sup>13</sup>, wherein the step of moving the capture assembly into alignment with the dispensing end of the customer selected queue includes moving and retaining the position of said capture assembly in the vertical direction into a vertical alignment accuracy of better or equal to 1/32 inch.

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18. The method of Claim ~~17~~<sup>13</sup>, wherein said gear drive motor operatively engages a rack member.

~~16~~  
20. A vending machine for beverages packaged in sealed containers, comprising:

- a. a storage facility defining an enclosed internal cavity and a container delivery port opening into said internal cavity;
- b. container holder within said internal cavity for holding a plurality of selectable sealed beverage containers; said container holder being disposed so as to define with said storage facility a vend selection space within said internal cavity;
- c. beverage container capturer for retainably removing one of said plurality of selectable beverage containers from said container holder in response to a vend control signal;
- d. a transport system operatively connected with said beverage container capturer for moving said beverage container capturer within said vend selection space in response to said vend control signal; and
- e. a control system operatively connected with said capturer and with said transport system for producing and providing said vend control signal thereto to cause said capturer and said transport system to cooperatively capture a selected beverage container from said container holder and smoothly carry said captured container through said vend selection space to said delivery port without dropping or subjecting said selected beverage container to sharp impact forces.

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21. The vending machine of Claim 20, further including a refrigeration unit operatively connected with said storage facility to cool at least a portion of said internal cavity.

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22. The vending machine of Claim 20, wherein said container holder includes a shelf operatively mounted within said internal cavity for maintaining said beverage containers in a plurality of selectable queues of said containers.

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22. The vending machine of Claim 22, further including a container release operatively connected with at least one of said queues adjacent said discharge end thereof for selectably retaining said beverage containers in said one queue.

<sup>24</sup>  
23. The vending machine of Claim 23, wherein said container release comprises only passive components.

<sup>25</sup>  
24. The vending machine of Claim 23, wherein said beverage container capturer includes means cooperatively engagable with said container release of said one queue for activating said container release when removing a container from said container holder.

<sup>22</sup>  
25. The vending machine of Claim <sup>21</sup>25, wherein said container release includes a cam assembly, and wherein said capturer cooperatively engages said cam assembly.

<sup>23</sup>  
26. The vending machine of Claim <sup>18</sup>22, wherein said shelf includes a means for maintaining said beverage container in said queues at an angle inclined with respect to the horizontal.

<sup>24</sup>  
27. The vending machine of Claim <sup>23</sup>27, wherein said angle is from about 8 degrees to 20 degrees with the horizontal.

<sup>25</sup>  
28. The vending machine of Claim <sup>16</sup>20, wherein said transport system comprises a rack and pinion system for operatively moving said beverage container capturer in said vend selection space relative to said container holder.

<sup>26</sup>  
29. The vending machine of Claim <sup>16</sup>20, wherein said transport system includes an X-Y drive apparatus for accurately moving said container capturer in two orthogonal directions within said vend selection space.

<sup>27</sup>  
30. The vending machine of Claim <sup>16</sup>20, further including a detection system operatively connected with said beverage container capturer for detecting the presence or absence of a said container within said beverage container capturer.

~~32. A vending machine for vending selectable products comprising:~~

- ~~a. a product storage chassis including a door, cooperatively forming an internal cavity; said chassis including a transparent panel portion for enabling viewing therethrough into said internal cavity and a product delivery port spaced from said transparent panel portion;~~
- ~~b. a product selector operable by a customer for generating a vend control signal indicative of a product selection of the customer;~~
- ~~c. a support operatively mounted within said internal cavity of the product storage chassis for supporting said products in a plurality of selectable and separate ordered queues of such products; and~~
- ~~d. a robotic assembly mounted to said chassis and operatively movable within said internal cavity in response to said vend control signal to rapidly and smoothly remove and carry a selected said product from its associated said ordered queue to a product delivery port without dropping or jarring the selected product; wherein a customer can view the entire product removal and carrying operations of a vending cycle of the machine through said transparent panel portion.~~

~~33. The vending machine of Claim 32, wherein said product delivery port includes a door and means cooperatively connected with said door for enabling opening of said door only when said selected product is present for removal at said delivery port.~~

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~~34. The vending machine of Claim 32, further including: (a.) a door operatively positioned to selectively open and close said delivery access port to access therethrough; and (b.) a lock operatively connected with said robotic assembly adjacent said product delivery port for locking said robotic assembly against movement whenever said door is open.~~

~~36. The vending machine of Claim 32, wherein said robotic assembly comprises:~~

- ~~a. an X-Y support frame mounted in said chassis and at one end of said support;~~

~~b. a shuttle, movably mounted to said X-Y support frame for controlled rapid uniform movement therealong in an X direction;~~

c. a carriage assembly operatively connected to said shuttle for controlled movement therealong in a Y direction;

d. a capture mechanism operatively mounted to said carriage assembly for removing and carrying said selected product from its associated ordered queue.

37. The vending machine of Claim 36, wherein said shuttle is mounted to said X-Y support frame by a rack and pinion assembly.

Sub 37 38. The vending machine of Claim 32, wherein said support is configured to support said products of differing shapes within said queues; and wherein said robotic assembly is operable to remove and carry said selected products of differing shapes.

~~39. The vending machine of Claim 32, wherein said support supports at least one of said plurality of ordered queues of said products at an inclined angle to the horizontal.~~

Sub 38 40. The vending machine of Claim 39, wherein said robotic assembly is operable to remove said selected products from said at least one inclined queue by sliding said selected products with the help of gravity into said robotic assembly.

Sub 39 41. The vending machine of Claim 39, wherein said support includes a low friction floor portion in said at least one of said queues disposed at an inclined angle for supporting said products within that queue.

~~42. A carriage assembly for use with a vending machine of the type having: a chassis defining an internal cavity, a front door forming one side of said chassis; a product support assembly mounted in said chassis and configured to hold a plurality of products to be vended in separate ordered queues of said products, such that one end of said queues address a dispensing end of said product support assembly, wherein the~~



~~volume between said dispensing ends of said product support assembly and said door defines a vend selection space; said carriage assembly comprising:~~

- ~~a. an X-rail assembly mounted to said chassis in generally horizontal orientation;~~
- ~~b. a Y-rail assembly mounted to said X-rail assembly in generally vertical orientation and configured for movement along said X-rail assembly;~~
- ~~c. an X-drive motor mounted for movement with said Y-rail assembly for controlling movement of said Y-rail assembly along said X-rail assembly;~~
- ~~d. a carriage mounted to said Y-rail assembly for movement therealong;~~
- ~~e. a Y-drive motor mounted for movement with said carriage for controlling movement of said carriage along said Y-rail assembly; and~~
- ~~f. said carriage assembly being configured to accurately move, position and hold said carriage relative to said product support assembly within said vend selection space.~~

43. The carriage assembly of Claim 42, wherein said X-rail assembly includes upper and lower spaced rails, and wherein said Y-rail assembly has opposed ends that are operatively mounted between said upper and lower spaced rails for movement therealong.

44. The carriage assembly of Claim 43, wherein said upper and lower rails comprise elongate gear racks, and wherein said X-drive motor comprises a motor with an output gear drive for cooperatively engaging at least a first of said spaced rails.

45. The carriage assembly of Claim 44, further including a gear extension operatively connected with said X-drive motor output gear drive and with a second of said spaced rails such that energization of said X-drive output gear drive simultaneously ~~positively moves the opposed ends of said Y-rail assembly along said spaced rails.~~

46. The carriage assembly of Claim 42, wherein said Y-rail assembly includes an elongate gear rack extending therealong, and wherein said Y-drive motor comprises a motor with an output drive gear mounted to cooperatively engage said elongate gear rack of said Y-rail assembly.

47. The carriage assembly of Claim 46, wherein said Y-drive motor is a dc motor, and further including a power control system connected with said Y-drive motor for providing a pulse-width-modulated drive signal to said Y-drive motor.

48. The carriage assembly of Claim 47, wherein said carriage can attain movement positioning and positional maintenance of said carriage along said Y-rail assembly to within an accuracy of 1/32 inch.

49. The carriage assembly of Claim 46, including a Y-position location sensor for accurately locating the vertical position of said carriage.

50. A product release and capture assembly for use in a vending machine of the type having: a chassis defining an internal cavity; a product support assembly mounted in said chassis and configured to hold a plurality of products to be vended in separate ordered queues of said products; said product support assembly being arranged and configured to define a dispensing end of said queues, wherein a vend selection space is defined in said internal cavity adjacent said dispensing ends of said queues; said product support assembly further including means for urging products in said queues to move toward the dispensing ends of said queues; a carriage; a driver connected to controllably move said carriage generally in an X-Y coordinate plane within said vend selection space into alignment with the dispensing end of a selected one of said product queues; said product release and capture assembly comprising:

a. an escapement mechanism mounted to said product support assembly of said selected one of said product queues adjacent the dispensing end thereof; said escapement mechanism comprising:



52. The product release and capture assembly of Claim 51, wherein said cam surface projects beyond the dispensing end of said product support assembly and at an angle relative to the general plane of said vend selection space.

53. The product release and capture assembly of Claim 50, wherein said connector is pivotally mounted to said product support assembly to one side of said selected queue of products and about a first upright axis extending generally perpendicular to a dispensing direction in which said products move in said queue.

54. The product release and capture assembly of Claim 53, wherein said connector slidably engages said first engagement member.

55. The product release and capture assembly of Claim 54, wherein said first engagement member is pivotally mounted to said product support assembly to one side of said selected queue of products and about a second upright axis spaced in the dispensing direction from the first upright axis and extending generally perpendicular to the dispensing direction.

56. The product release and capture assembly of Claim 55, wherein said connector defines a slot therethrough; wherein said first engagement member extends through said slot; and wherein an edge of said slot slidably engages said first engagement member to pivot said first engagement member about said second axis.

57. The product release and capture assembly of Claim 56, wherein said first engagement member includes an arm portion extending from said second pivot axis toward a distal end, and a product engaging stop member connected at said distal end.

58. The product release and capture assembly of Claim 57, wherein said arm portion of said first engagement member extends through said connector slot; and wherein said connector and said first engagement member are cooperatively operable such that when

said first engagement member is disposed in its engaged position, said arm portion of said first engagement member lies generally perpendicular to the dispensing direction, placing said product engaging stop member in the path of said first-in-line product of said queue; and when said first engagement member is disposed in its disengaged position, said arm portion thereof lies generally parallel to said dispensing direction, with said product engaging stop member being positioned to one side of the first-in-line product as it advances in the dispensing direction.

59. The product release and capture assembly of Claim 54, wherein said connector includes a rear pivot arm portion extending from said first pivot axis back toward said second engagement member, and a forward pivot arm portion extending from said first pivot axis toward said dispensing end and said force receiving surface.

60. The product release and capture assembly of Claim 53, wherein said escapement mechanism further includes a generally vertical wall member for retaining one side of said products within said selected queue, and wherein said connector is pivotally mounted to said wall member.

61. The product release and capture assembly of Claim 53, wherein said escapement mechanism further includes a generally vertical wall member of retaining one side of said products within said selected queue, and wherein said connector and said first engagement members are mounted about said first and said second pivot axes respectively to said wall.

62. The product release and capture assembly of Claim 50, wherein said escapement mechanism includes only passive components requiring no power energy sources.

63. The product release and capture assembly of Claim 50, wherein said capture receptacle is pivotally mounted to said carriage about a generally horizontal pivot axis, generally perpendicular to a dispensing direction in which said products move in the

~~queue; wherein said capture receptacle slidably engages said force-receiving surface as it moves to its said second position.~~

64. The product release and capture assembly of Claim 50, wherein said capture receptacle includes a floor portion configured to retainably support at least one of said products of said selected queue, said capture receptacle being configured such that said floor portion thereof aligns with a floor portion of said selected queue when said capture receptacle is positioned in its said second position; wherein said first-in-line product of said selected queue can smoothly slide from the dispensing end of said selected queue onto side floor portion of said capture receptacle.

65. The product release and capture assembly of Claim 50, wherein said capture receptacle includes a sensor for detecting the presence or absence of said product in said capture receptacle.

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